Study on the Method to Determine Grouping Analysis Range for KAERI’s Radioactive Waste Using Concentration Averaging Method

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1. Introduction

Nuclear Chemistry Research Division at the Korea Atomic Energy Research Institute (KAERI) has used the grouping method for efficient radioactive waste analysis during the sampling. However, it is currently not easy to apply the grouping method due to the difficulty of decision on optimum amount of drum for grouping and proving its validity.

In this study, we applied the waste concentration averaging method proposed by US NRC [1] to KAERI’s radioactive waste. Through this review, we would like to propose a method to determine the reasonable range for grouping analysis.

2. Background of the Idea

2.1 Review of the Concentration Averaging Method

According to NRC, the radioactive waste can be divided into two categories, one is “blendable waste” and another is “discrete items”. If each waste with certain radionuclide concentration is mixed together under the certain threshold (volume or concentration), the total radionuclide activities in the wastes can be averaged by its total volume or mass without additional blending of the wastes. And the averaging method are described in the document of NRC [1].

2.2 Applying the Averaging Method to the Grouping Range Determination

The grouping analysis is based on a fact that radioactive waste packages composed of same material with identical generation history would have same radiological characteristics. So, analysis result for representative sample can be applied to each single package. This method presupposes that a single measurement value for a well-made composite sample will be close to the average concentration value of the individual components of the composite sample. That is, the range of the volume or concentration allowed to average the concentration of the individual measurement values is equivalent to the concept of the grouping range for making a composite sample.

Based on the above information, we have demonstrated that the method of decision on the allowable range of concentration averaging described in CA BTP could be applied to the method of determining the allowable grouping range.

3. Suggestions on the Methodology of Grouping Range Determination

Prior to set the grouping range, it is necessary to classify KAERI’s waste according to the classification standards proposed by NRC (blendable waste or discrete items) through reviewing the record history of each waste. Then, the standard value of radionuclide concentration for each type of wastes should be determined.

After the above process, grouping range determination has been performed based on the waste type as follows.

3.1 In case of Blendable Waste

Once the waste is classified as blendable waste, the procedure for decision on grouping range is as shown in Fig. 1.
Fig. 1. Method of Determining Grouping Range (In Case of Blendable Waste).

The method to calculate “sum of fractions” and volume threshold shown in Table 1 are described in the document [1].

Table 1. Thresholds for Demonstrating Adequate Blending Characteristics of most concentrated influent waste stream

<table>
<thead>
<tr>
<th>Sum of fractions</th>
<th>Volume of Mixture in m³ (ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 10</td>
<td>Class A Mixture</td>
</tr>
<tr>
<td></td>
<td>No Limit</td>
</tr>
<tr>
<td>between 10 and 20</td>
<td>No Limit</td>
</tr>
<tr>
<td>between 20 and 30</td>
<td>60 (2100)</td>
</tr>
<tr>
<td>between 30 and 50</td>
<td>20 (700)</td>
</tr>
<tr>
<td>between 50 and 100</td>
<td>6 (210)</td>
</tr>
</tbody>
</table>

3.2 In case of Discrete Items

In case of discrete items, the procedure for determining grouping range is as follows. First, waste class should be estimated in the same way as blendable waste. Then, allowable range of concentration averaging should be estimated for primary gamma-emitting radionuclides and for radionuclides of concern that are not primary gamma-emitter, respectively. The procedure of determining the concentration limit in each case is shown in Fig. 2.

Fig. 2. Procedure of Determining the Concentration Limit for Concentration Averaging.

The concentration limit is the standard value depending on waste class described in NRC 10CFR 61.55 [2].

Through the above procedure, it is possible to determine the maximum allowable concentration standard value that can be averaged. And to estimate the maximum amount of drums that can be grouped for analysis is possible by comparing the initial determined concentration value with allowable concentration standard value.

4. Conclusion

In this study, we proposed a method to determine the range of grouping KAERI’s waste using NRC concentration averaging method. By developing this method further, it may help solve the grouping issues. And if this method is established appropriately, the analysis efficiency will increase and also transportation of radioactive waste to the final repository will be promoted. Also, efficient analysis of wastes can be conducted when the large quantities of wastes are generated by dismantling of nuclear power plant in the future.

REFERENCES